MagTreat
By Brucite+

Recommendations

MagTreat® in wastewater treatment

Description and application

MagTreat® magnesium hydroxide is a milled brucite mineral used for wastewater and exhaust gas treatment. It is produced in the form of a powder, a suspension and a granular product.

It is an odorless white substance, the granular product has a tint from light gray to light brown. The product is not a chemical; it is produced by grinding and subsequent hydration of the natural mineral brucite.

MagTreat® is as a concentrated suspension used for the neutralization of acidic effluents, precipitation of heavy metals, reduction of hydrogen sulfide emissions COD and phosphates, and improving filtration properties of treated sludge, often producing lower levels of solid waste. Customers can prepare a diluted suspension from water and the powder we offer. The granular product is used in industrial filters for neutralization and as a filter medium in drinking water treatment.

How does MagTreat® work?

Magnesium hydroxide is classified as sparingly soluble in water. Inside wastewaters with an acidic reaction MagTreat® begins to dissolve gradually releasing magnesium cations and hydroxide anions that neutralize the acids. Due to the limited solubility MagTreat® is consumed gradually, providing the system with a “buffer effect”. Divalent Mg^{2+} cations are involved in the processes of coagulation, compaction of sewage sludge, and are also micronutrients for activated sludge bacteria. Due to the formation of insoluble or poorly soluble salts with various anions, MagTreat® is used to precipitate phosphates, magnesium-ammonium phosphates, fluorides, regulates the content of sulfides, reduction of odor in the wastewater treatment plant. Hydroxide anions promote the precipitation of heavy metals in the form of insoluble hydroxides. Magnesium hydroxide forms insoluble magnesium-ammonium phosphate with phosphate and ammonium ions, decreasing N and P load in wastewaters.

Application

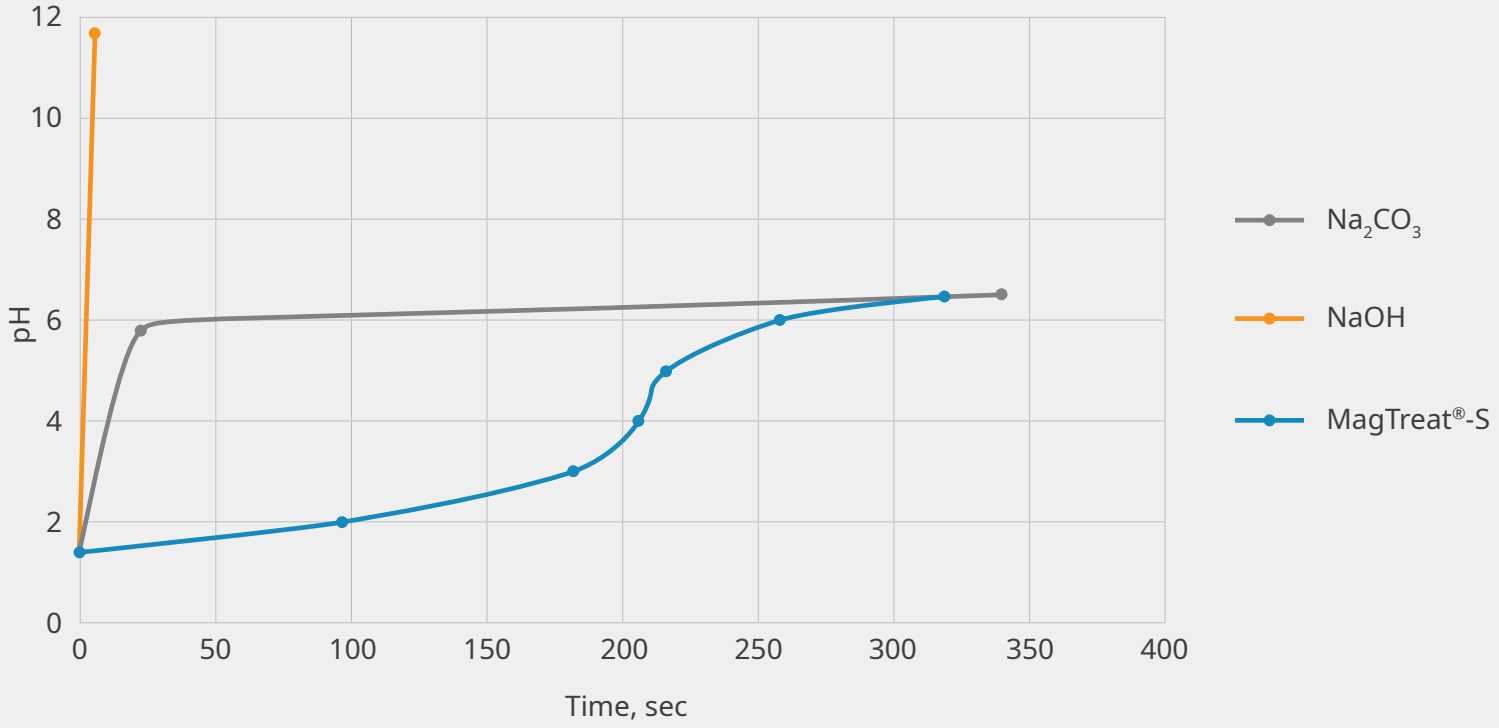
The dosage of the product depends on the treatment aim that the consumer sets.

Table 1. Recommended dosages of MagTreat® depending on the area of application.

Application	Parameter range	Effect on parameter	Dosage of MagTreat®-S 65%
Phosphate reduction	from 30-40 ppm till 12–20 ppm PO_4-P	50% reduction	5–2,0 ppm (0,93–1,2 ml/l)
Heavy metal precipitation	pH from 4 till 8,5; if starting concentration of Cr^{3+}=2000 mg/l	112 % increase (at 4,5 pH units), precipitation of Chromium as a hydroxide	2,3 kg/m^3
COD reduction	from 40000 mg/l till 28000 mg/l	30% reduction	3,5 g/l
Whey neutralization	From pH 4 till pH 7	75% increase (at 3 pH units)	6,4 g/l
Inorganic acid neutralization (hydrochloric acid 0.1 M)	From pH 1,3 till 7,4	Increase at 6.1 pH units	6,4 g/l
Neutralization of organic acids (acetic acid 0.1 M)	From pH 3,1 till 7,4	Increase at 4.3 pH units	6,4 г/л

Application

Magnesium hydroxide reacts more slowly than solutions of other alkalis, but at the same time contains more hydroxide ions per ton of product.



Pic. 1. Change in pH of a solution of 0.1 M HCl with the addition of alkaline reagents; stirring 1000 rpm, T = 22° C.

Application

Table 2. Properties of commercially available alkalis in comparison with MagTreat®

Chemical formula	$Mg(OH)_2$		NaOH		CaO	$Ca(OH)_2$		Na_2CO_3	NH_3*H_2O
Delivery form	100% solid	65% aqueous suspension	100% solid	50% solution	100% solid	100% solid	30% slurry	100% solid	25% solution
Chemical name	Magnesium hydroxide		Sodium hydroxide		Calcium oxide	Calcium hydroxide		Sodium carbonate	Ammonium hydroxide
Alternative name	MagTreat®-P	MagTreat®-S	Caustic, caustic soda		Lime	Quick lime	Milk of lime	Soda ash	Ammonia water
CAS	1317–43–7		1310–73–2		1305–78–8	1305–62–0		497–19–8	1336–21–6
Solution density, kg/m³		1650		1520			1220		901
Molecular mass, g/moll	58		40		56	74		106	35
Maximum pH raise	9,5		14		12	12		11	11
Dangerous? Hazard statements	no		High H314 — Causes severe skin burns and eye damage. H402 — Harmful to aquatic life		High H315 Causes skin irritation. H318 Causes serious eye damage. H335 May cause respiratory irritation	2 High H315: Causes skin irritation H318: Causes serious eye damage H335: May cause respiratory irritation		Medium H319: Causes serious eye irritation	Medium H314 Causes severe skin burns and eye damage. Ammonia solution 24,9% Page 1 of 9 H335 May cause respiratory irritation.
Moll of OH- ions per 1 ton of reagent, moll*103	30,7	19,9	25	12,5	35,7	27,0	8	18,9	7,1
Moll of OH- ions per 1 m³ of reagent, moll*103		32,9		19,0			9,9		6,4
1 ton of MagTreat®-P =		1,5	1,2	2,5	0,9	1,1	3,8	1,6	4,3
1 ton of MagTreat®-S 65% =	0,7		0,8	1,6	0,6	0,7	2,5	1,1	2,8
1m3 of MagTreat®-S 65% =				1,7			3,3		5,1

Lab trials instruction

The procedure for the comparative test of MagTreat® with NaOH solution (caustic) is described below:

1. It is necessary to select the average influent (5–6 liters), to mix it, then to pour into a glass/plastic cylinder (recommended volume 0.5–1 liter). It is important to make sure that the temperature of the influent sample is approximately equal to the actual temperature of the influent stream during neutralization at the facility.

2. To stir the MagTreat® suspension for at least 3 minutes (shake). It is advisable to prepare 2 small syringes (5 ml) for dosing of both the suspension and NaOH solution. Suspension is completely ready for use and does not require dilution with water.

3. Calculate the approximate amount of MagTreat® that is required for neutralization, based on the current caustic consumption in your facility. However, it is better to pretitrate the sample of influent by caustic (2-3 times) and to use this data for the calculation of MagTreat® dosage by the equation:

The quantity of suspension MagTreat®-S 65%, grams = 0,0120 malk Walk, where Walk is the concentration of the caustic solution for neutralization, in %; malk is the mass of the caustic solution for neutralization, in grams. The caustic-treated sample should be left for comparison in step 7.

4. It is important to provide good mixing of the reagent during the reaction. To do this, use 2 magnetic stirrers to conduct 2 parallel experiments.

5. Gradually, with stirring, add the reagent dropwise from the syringe, controlling the pH of the solution. After each addition, weight the amount of material remaining in the syringe. Upon reaching the desired pH, record the exact amount of reagent in grams for neutralization. When adding MagTreat®, it is important to give the next dose of the suspension some time to react (15–20 minutes).

Note. Since the mass calculated in step 3 may be very small, it is extremely important that the entire MagTreat® is added to the influent sample. It is necessary that the balance is able to take into account a small suspension weight when dosing from a syringe drop by drop.

6. Repeat step 5 three times and write down an average result.

7. Estimate the time required to reach the desired pH using the MagTreat® suspension. To do this, add to the fresh sample

Lab trials instruction

of the influent the entire amount of MagTreat® calculated in step 3. Considering that in real life, systems with clarifiers/neutralization basins provide additional reaction time, compare the required reaction time with the measured neutralization time for MagTreat®. Usually the pH in the system with MagTreat® is set in 20–40 minutes. If you need a faster rate of increase in pH, try adding a small excess of MagTreat®, repeating step 6 with a fresh sample of influent.

Note. A small excess is from 10% to 30% of the MagTreat®. It is not recommended to add more than 30%, as this will lead to inefficient use of magnesium hydroxide, which can settle in the system and increase TSS.

8. At the completion of steps 6 and 7, you can add a flocculent used in a particular production. In this case, it is necessary to avoid excessive mixing of the sample effluent, which can damage the operation of the flocculants.

9. Let the neutralized solution settle in the cylinders to understand how the precipitation occurs. Determine the observation time, for example 1 hour. Detect visually with the help of labels on the cylinder the difference in appearance, volume and % of solid sediment particles generated by MagTreat® and NaOH.

10. Filter the treated solution and measure the heavy metal content of the filtrate. Compare with the metal content in the influent sample.

11. To compare the economic efficiency of reagents, it is necessary to compare the quantity of each substance in terms of dry solids basis. For MagTreat®, the amount of suspension for neutralization should be multiplied by 0.65 (as the suspension contains 65 % of the solids). Economic efficiency is also influenced by

a) The fact of reducing the volume of sludge and reducing its hazard class using MagTreat® (reducing the cost of disposal of solid wastes).

b) Reducing the consumption of organic and inorganic (Fe and Al salts) flocculants/coagulants Phosphorus reduction (P-reduction) Phosphorus reduction mechanism is based on formation of water insoluble magnesium phosphate and/or magnesium ammonium phosphate (MAP) — struvite:

$3Mg^{2+} + 2PO_4^{3-} = Mg_3(PO_4)_2 \downarrow$ or

$Mg^{2+} + NH_4^{+} + PO_4^{3-} = MgNH_4(PO_4) \downarrow$

Starting dosage for laboratory trials can be chosen according to the approved working dosage of our customer (food producer):

Lab trials instruction

0.5–2.0 ppm (0,93–1,2 ml/l) to reduce Orto-P (PO4-P) from 30–40 ppm to 15–20 ppm (50% reduction).

During comparison in a lab it is necessary to provide sufficient mixing time (30 min) and sedimentation time after mixing (90 min) before analyzing of PO_4-P content in the filtrate. Anyway, the dosage should be approved during industrial trials and it will probably decrease.

Laboratory experiments will give you an idea of the behavior of the reagent. But to evaluate all the benefits of MagTreat®, we recommend to carry out industrial trials, since some of the benefits will appear after magnesium hydroxide has filled the system. It is also necessary to take into account that the dosage of the reagent obtained in the laboratory can be reduced with long-term use of MagTreat®.

MagTreat® is supplied in the form of a suspension, powder and granular product. Depending on the form of delivery, the product can be used in three ways:

1. Dosing the concentrated suspension in the system.
2. Preparation of diluted suspension by customer.
3. Filling the granular product into the filters.

1. Dosing the concentrated suspension in the system

The product can be dosed both from containers (IBCs) and from storage tanks (for deliveries in tankers). The suspension of magnesium hydroxide MagTreat® should be dosed in the area of maximum mixing of effluents using a peristaltic or screw pump. It is necessary to provide periodic mixing of the product.

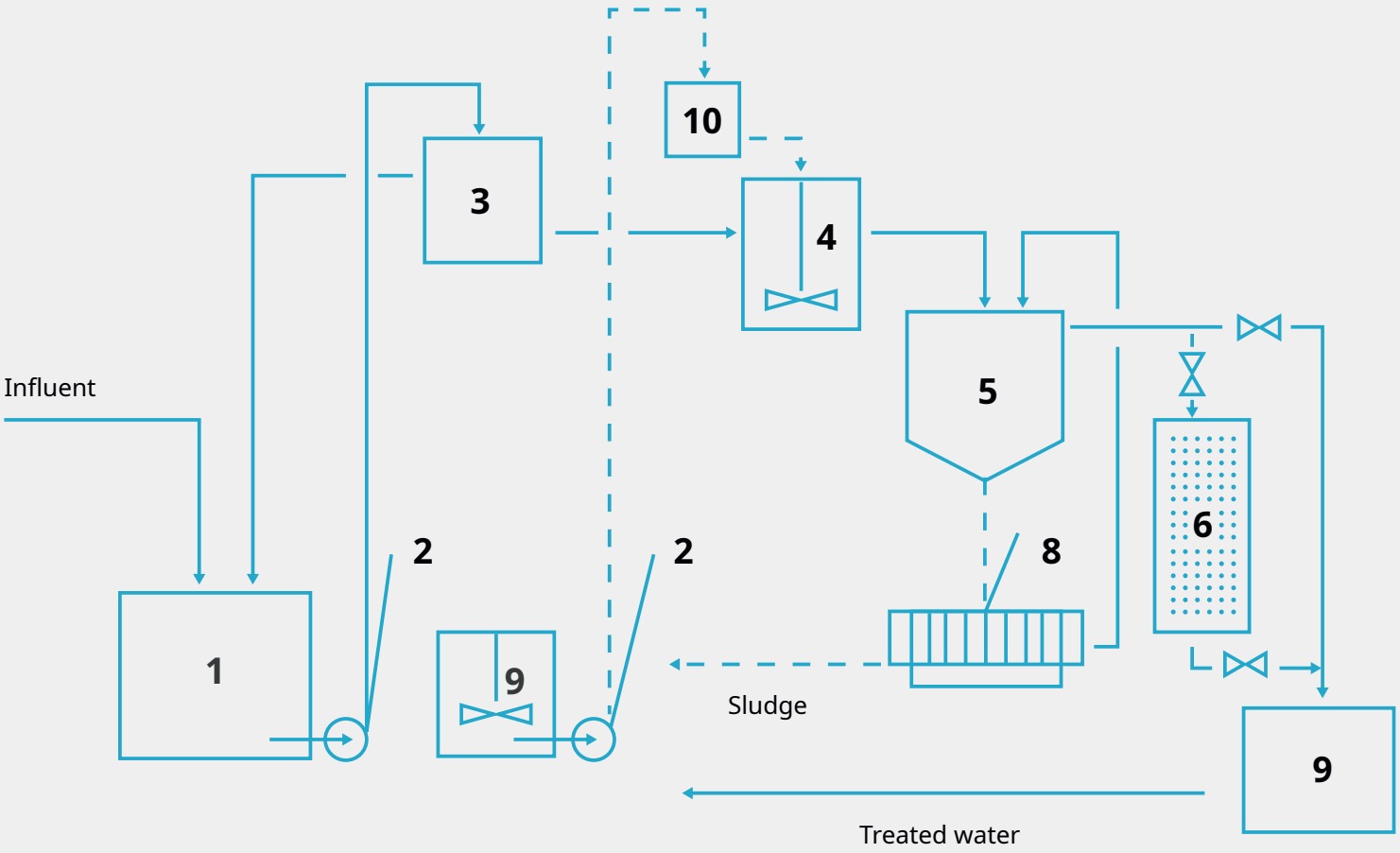
Please read the rules for handling the finished suspension in Appendix 1.

2. Preparation of diluted suspension by customer

The customer can prepare a suspension with a concentration of up to 35 % solids by mixing MagTreat®-P powder and water. A further increase in concentration is impossible without the use of special dispersing agents.

The dosage scheme is shown in Pic. 1.

Lab trials instruction



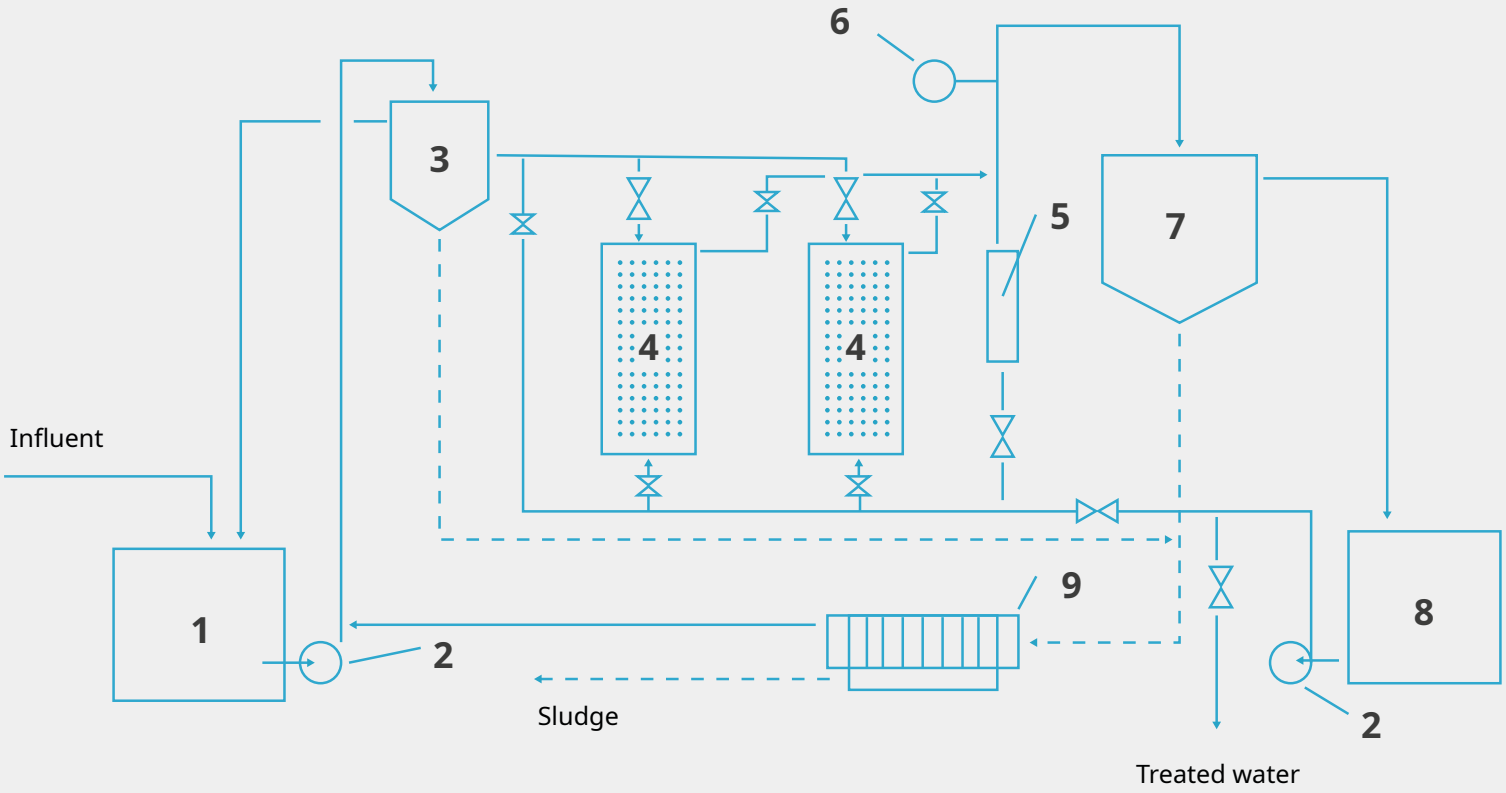
Pic. 2. Schematic diagram of the neutralization and treatment of acidic wastewater using brucite powder: 1 — wastewater tank; 2 — pumps; 3 — constant pressure tank; 4 — reaction tank; 5 — clarifier; 6 — aftertreatment filter; 7 — purified water storage; 8 — sediment treatment unit; 9 — brucite suspension preparation unit; 10 — brucite suspension dispenser.

Lab trials instruction

When dispensing a diluted suspension, special attention should be paid to the constant mixing of the product (as solid particles settle rapidly) and to flushing the dosing lines.
The recommendations given in Appendix 1 must be followed.

3. Filling the grounded product into the filters

It assumes that the customer has pH neutralizers.



Pic. 3. Schematic diagram of the neutralization and treatment of acidic wastewater by filtration through grounded brucite: 1 — wastewaters tank; 2 — pumps; 3 — constant pressure tank; 4 — filters with brucite load; 5 — flow meter; 6 — manometer; 7 — clarifier; 8 — purified water storage; 9 — sediment processing unit.

Lab trials instruction

It is possible to use the grounded MagTreat® product in drinking water treatment. Backfill occurs in pressure filters with a flushing unit. It is recommended that you fill up no more than 2/3 of the volume of the filter flask in order to leave room for backwashing. If the source water contains high concentrations of iron and manganese (20 mg/l and 3 mg/l, respectively), then they should be pre-oxidized in the storage tank by dosing sodium hypochlorite. After that, you can remove the residual concentration of MagTreat® elements.

When filling the filter with only grounded brucite, 28 l MagTreat® fils 1054 flask, while MagTreat® 2000 should be filled with 28–33 kg, taking into account the bulk density of the material. For the 0844 flask it's enough 15–18 kg of MagTreat® 2000.

MagTreat® removes heavy metals from water. According to the results of the research, a decrease in the concentration of iron from 24 to 0.32 mg/l (98 %), copper from 22 to 0.17 mg/l (99 %), zinc from 135 to 0.48 mg/l (99.5 %) was observed in the lab. The average filtration rate in the experiments was 3 m/h on the filter columns, the initial pH of the effluent was 2.6.

It is also noted that the "Absorption capacity" of granular brucite for hydrogen ions and metal ions reaches 750–1000 gram-equivalents per 1 m^3 of load, which is close to the absorption capacity of synthetic ion-exchange materials. The extraction efficiency of metal ions can be increased by increasing the filter load layer.

MagTreat® advantages

- The most profitable alkali compared with others on the market.
- Suspension with the highest percentage of solids on the market — 65 %.
- Non-toxic, safe for the environment and handling.
- Non-corrosive.
- Predictably increases pH and alkalinity (buffering effect)
- Reduces COD.
- Reduces odor, fats, oils and grease (FOG), prevents corrosion of water treatment systems.
- Improves dewatering of sludge, reduces its hazard class.
- Precipitates heavy metals and phosphates.

Appendix 1

Rules for handling the final suspension

The product can be dosed both from containers (IBC) and from storage tanks (for deliveries in car tanks). The suspension of magnesium hydroxide MagTreat® should be dosed in the area of maximum mixing of effluents using a peristaltic, screw or diaphragm pump. It is necessary to ensure periodic mixing of the product and follow the recommendations below.

Unloading of the material

Truck cars are unloaded by pumping or pressurizing the car. If pumping method is used it is recommended to circulate the product via pump before unloading to a storage tank. When designing unloading line, it is recommended to include mesh filters with ≤1 mm holes to prevent blockage with possible agglomerates in suspension. When unloading material from IBC, one should resuspend the suspension by folding IBC mechanical mixer or compressed air within 10 minutes.

Storage conditions

Suspension should be stored inside the warehouses or in open areas under a canopy, under conditions that exclude exposure to water and corrosive media (acids, alkalis), at positive temperatures from +2° C to +35° C. When storing outside the warehouse, please, avoid direct sun exposure. The guaranteed shelf life of the suspension is 6 months upon delivery to a customers' warehouse.

Despite the fact that MagTreat® suspension has long-term stability, when stored in the warehouse without stirring for more than 1 month, a transparent layer of water appears on top. This is normal and does not affect its mixing and transferring to a uniform state.

Mixing is necessary to prevent the deposition of solids. This can be done by mechanically mixing or sparging the air through the suspension.

During long-term storage (more than 1 month) it is necessary to periodically mix the suspension once every 2 months using a mechanical mixing device or sparging the air till suspension turns homogeneous.

Appendix 1

Rules for handling the final suspension

Mechanical stirrers come in various designs; paddle, propeller or frame mixers can be used. A sufficient speed of the stirrer for stirring the suspension during storage is 50–60 rpm.

When mixing the suspension in tanks larger than 1 m 3, stirrers with an upper inlet should be used. They provide greater efficiency (require less power) and ease of maintenance.

For mixing with compressed air, it is necessary to provide aerators at the bottom of the storage tank. For greater efficiency, place them with the holes down.

In the case of periodic supply of the suspension with interruptions of more than 24 hours, thorough mixing of the product immediately before use for 4–8 hours is recommended.

Reservoirs for storage

The most preferred materials for storage/dosing tanks are carbon steel, fiberglass or polymeric materials. Aluminum is incompatible with magnesium hydroxide suspension due to corrosion.

IMPORTANT: Storage tanks should be installed as close as possible to the dosing point in order to prevent clogging of the pipelines!

Vertical tanks are preferable to horizontal ones, since they take up less space, they are easier to fix on concrete bases, and it is easier to organize mixing in them. As a rule, a tank should have a capacity of 1.5 times the size of the tank in which the material is delivered in order to have an extra space for rinsing water. Vertical tanks with a height/diameter between 1.0 and 1.2 are preferred. All tanks should be fitted with baffles set 90° apart to prevent vortex formation during mechanical agitation. Baffles should measure 1/10th of the tank diameter and should extend to 30 cm above the bottom of the tank.

Special insulation is not required if the tank stays at a temperature above +2° C. If the ambient temperature is below +2° C, the tank must be isolated and/or heated to prevent freezing of the suspension. Heat can be applied using self-regulating electrical tape or a cable on the outside of the tank.

Appendix 1

Rules for handling the final suspension

When storing the material in the tank outdoors in case of high ambient temperature (above +35° C), water dispensers can be installed inside the tank to prevent evaporation losses. The dilution of the suspension should be not more than 5% of the total volume.

Tanks should have a connection to the atmosphere. This can be implemented through a vent with a water seal or by installing a ventilation pipe. It is especially important to provide an appropriate design in the case of mixing the suspension with compressed air and/or purging the dosing line with compressed air.

Dosing lines

For magnesium hydroxide suspension suitable pipes are carbon steel or plastic ones. Various hoses can be used, including reinforced PVC and rubber hoses. If possible, pipes should be installed above ground and easily accessible for maintenance. The minimum diameter of the hoses is ½" (12.7 mm).

If the pipelines are located in areas with extreme temperatures (below +2° C or above +35° C), they should be heated or insulated. This can be performed with self-regulating heating tape or cable. It is not recommended to use steam heating of the tank, as high temperatures can dry magnesium hydroxide on the walls of tanks and pipes. To prevent blockages, it is important to ensure that the suspension circulates through all the pipelines and to plan a minimum of turns in the system, as well as provide a flushing circuit with tap water supply. To remove residual water

Appendix 1

Rules for handling the final suspension

and suspension material after washing, it is recommended to connect a compressed air line to the system (see Appendix 2).

Pipes should go horizontally or be below the valves and inlets of the pumps, which prevents the precipitation of magnesium hydroxide particles in these places. Since friction and pressure loss in suspension pipelines are higher than those of water, a minimum pipe diameter of 1.25 times the discharge size of the pump is recommended. Suction lines from the storage tank to the feed pump should be kept as short as possible. Suction lines should be at least two times the size of the suction of the pump being used. Minimum pump or valve inlet diameter is ½" (12.7 mm).

The storage tank discharge and dosing pump inlet must be located less than 1 m of one another. Piping from the tank and pump should be installed in the following manner: from the storage tank start with a close nipple, valve, close nipple, tee, nipple (30 cm or less), pump, close nipple, tee then continue with discharge piping. On the tee's install a close nipple and ball valve for water flushing. For details, see the diagram in Appendix 2. It is recommended to install a transparent section of polycarbonate pipe for visual control of the suspension supply.

Additionally, it is recommended to install a pressure gauge on the material supply line to control the operating pressure in the system. A decrease in operating pressure is a signal that the system is not tight, the pump is worn, or the suspension is solidified.

Valves and fittings

Ball valves are preferable to wedge gate valves and other types of valves. Use a pinch type valves to control the flow of the suspension (pneumatically or mechanically actuated). Such valves are closed to 100% even in the presence of solid particles in the pipe.

For connecting flexible hoses with a pump and an IBC, it is recommended to use quick-disconnect fittings.

Appendix 1

Rules for handling the final suspension

Pumps

When high capacity is required, for example, when unloading suspension from or loading it into a tank, it is recommended to use a screw or industrial peristaltic (hose) pump.

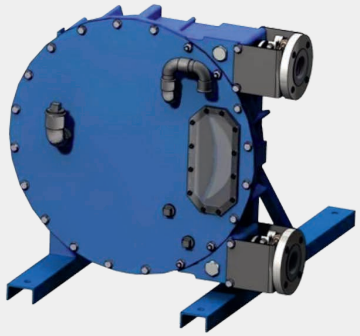
The minimum diameter of the pump inlet is ½" (12.7 mm).

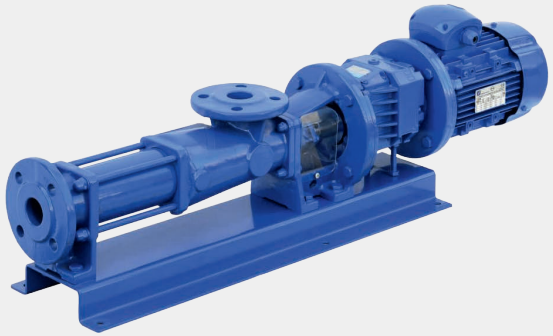
When accurate dosing and low capacity are required, it is recommended to use peristaltic laboratory or industrial pumps.

Such devices are often equipped with LED displays to indicate information on the dosage of the material.

For internal hoses, natural rubber is the preferred material. Calibration of the pump flow with a graduated measuring cylinder and a balance is mandatory.

When choosing a pump, it is necessary to pay attention to the characteristics of the material: viscosity 100–650 cPs, the concentration of solids (65 %) and their hardness (2,7 on the Mohs scale), as well as take into account the maximum speed and recommendations for pumping abrasive suspension. All these parameters have a direct impact on the service life of the pump components. Please contact your local pump manufacturers for more detailed service.





Appendix 1

Rules for handling the final suspension

Maintenance

Handling the suspension requires routine maintenance. If dosing occurs daily in a continuous mode, then during operation a monthly inspection of the storage tank for leakages is required. Also material accumulated on the side walls of the storage tank should be cleaned every month. Cleaning the bottom of the tank should be carried out before the next filling of the tank or every 6 months.

In case of a periodic dosing system, pumps and valves should be checked before each start and rinsed with water not later than in 2 hours after dosing stop in order to avoid clogging with the dried material!

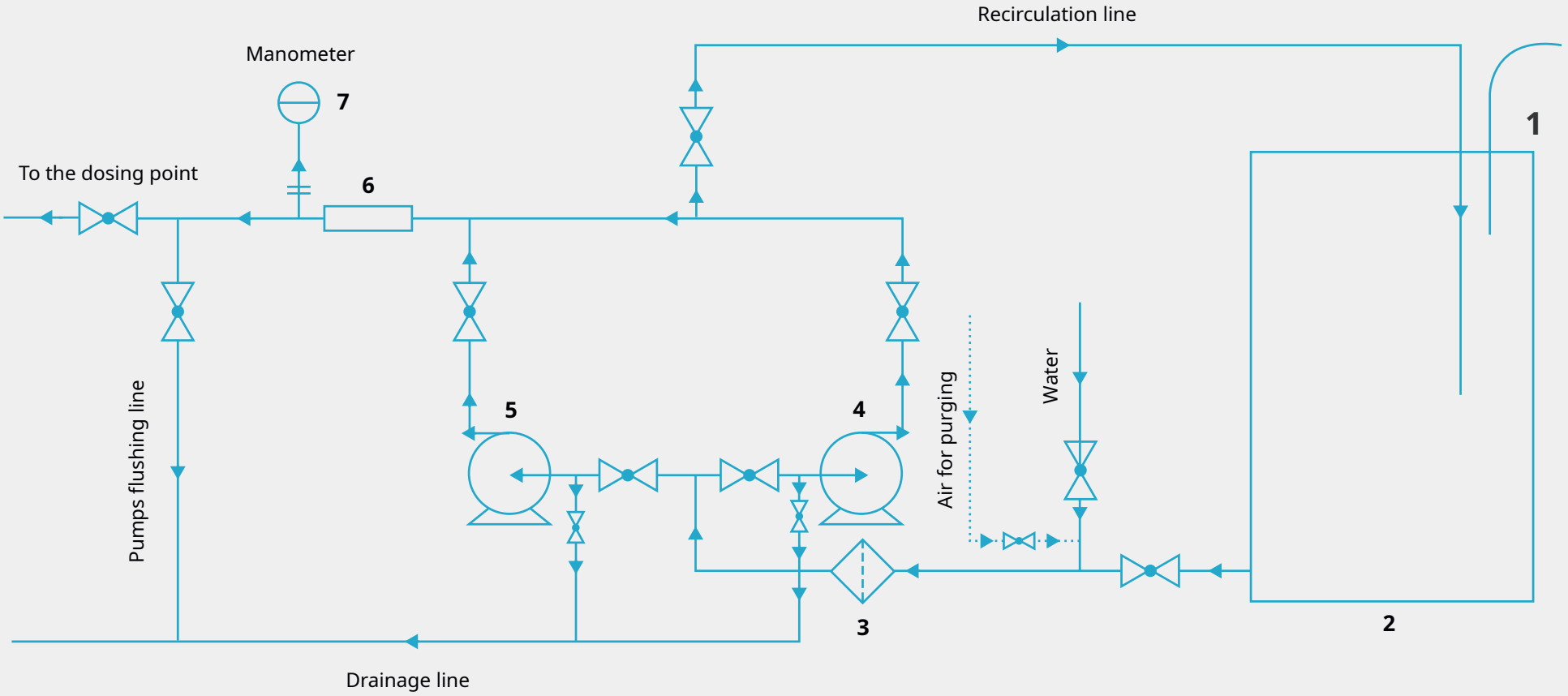
Flush the dosing lines only with tap water without adding any special agents, acids, alkalis or surfactants. When flushing the pump into the storage tank through the drainage line, it is important not to add too much water. Excess water will affect the stability of the suspension and lead to more rapid precipitation of the solids.

At the end of flushing, it is advisable to blow the system with compressed air if the air supply line is included in the general circuit (see Appendix 2).

Monthly, one should check the wear of the pump or track it with the pressure level in the system. This will prevent material leakage and supply problems, will allow to determine the schedule for replacing the hose or stator.

Appendix 2

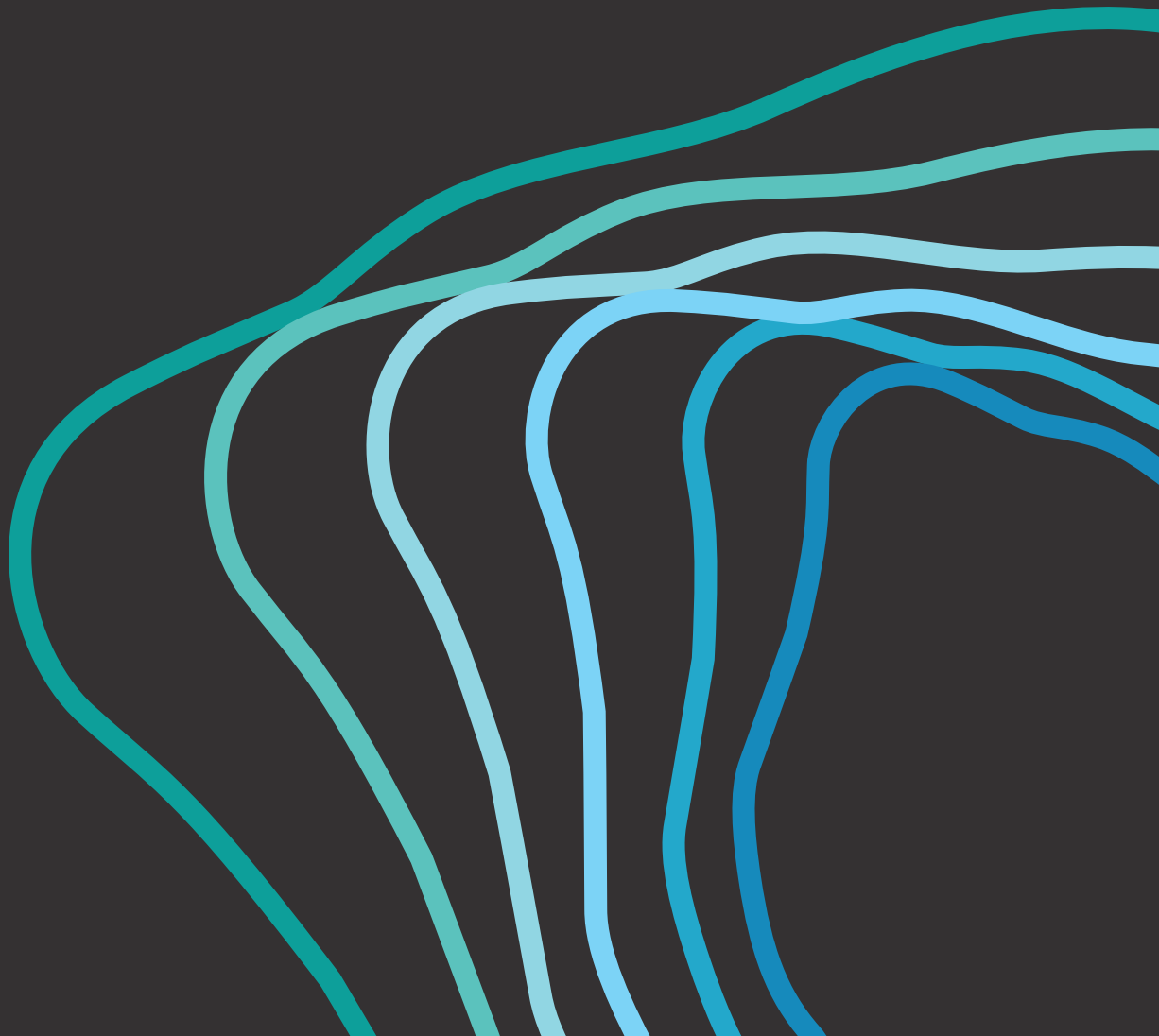
Storage and dosing scheme for magnesium hydroxide suspension



1 — ventilation; 2 — reservoir for suspension storage; 3 — mesh filter; 4 — main dosing pump; 5 — reserved dosing pump; 6 — area from transparent material (polycarbonate); 7 — manometer for detection of working pressure and possible leakages

By choosing MagTreat® products you ensure best technical support for application of product and receive a possibility to develop a custom solution with individual properties.

Please contact us via request form.



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